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VISION FOR THE ENGAGEMENT OF THE E-FACILITATOR IN SCHOOL IN THE INSPIRING SCIENCE EDUCATION ENVIRONMENT

Radoslav Yoshinov, Monka Kotseva

Abstract. The Inspiring Science Education project is all about elaborating a learning environment using an inquiry based learning (IBL) approach. The Inspiring Science Education portal as a main part of the environment is the place where a registered user can find (create) eLearning Tools and digital educational resources, which can be used in class and as a place to connect with like-minded teachers and schools around Europe to share experiences and collaborate on projects. On the other hand, starting from 2009 in various EU countries, including Bulgaria, research was done to describe and categorize the professional profile of the e-facilitator, carrier of the mission to overcome digital divide between the generations, through implementing ICT knowledge. Our team worked on the requirements and explored the need for an e-facilitator in school as a major ICT expert and consultant, who empowers access to the electronic services in the e-education space, facilitates links with virtual libraries, acts as initiator and architect of social communication by forming communities involving all participants in the learning process—students, teachers, parents, administration, etc. This paper expresses the author's projection of the roles and functionalities of the e-facilitator in school in the Inspiring Science Education environment.

ACM Computing Classification System (1998): K.3.1.

Key words: technology-based learning, e-learning tools, TPACK model, learning styles, e-facilitator.

1. Introduction.

Overview of the Project ISE. Science is the overarching search for knowledge and understanding that we, as living beings, must invest into. We must all be aware of our place in the cosmos, of the frailty of our adaptation to existing conditions on this beautiful and unique pale blue dot. The new generations lack basic knowledge of science's simple concepts and totally lack the skills to make judicious decisions and wise choices on issues in our daily lives. The Inspire Science Education (ISE) project is designed to address this growing problem and to elaborate solutions and present them to educators. The main goal is to bridge the knowledge gap by providing the necessary tools and resources alongside the basic concepts and skills of the science-literate student. He should be able to: understand the core principles of science; find and properly assess information; communicate his ideas in an articulated way and be able to make responsible decisions [2, 3]. Thus the mission of ISE is to provide digital resources and opportunities for teachers to help them make science education more attractive and relevant to students' lives. Users of the ISE environment should be aware of the existence of information, of how to find and use it for different scientific purposes. This will be achieved through elaboration of the ISE WEB learning environment (Fig. 1), a social empowered portal containing a learning management system, authoring tools for digital content creation, a content management system with a large repository of digital education materials, tools for creating lesson and course scenario based on communal constructivism, tools for social extensions – creating international, national, regional, local and thematic

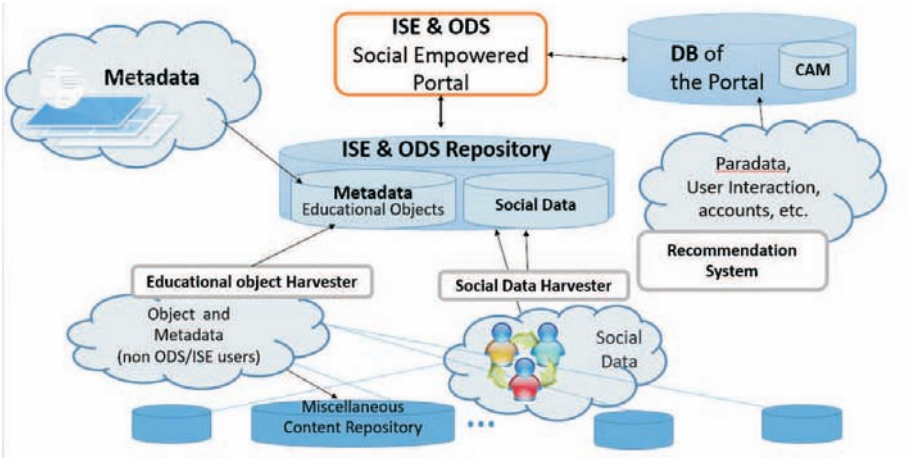

Fig. 1. Principal Architecture of the ODS&ISE WEB environment

communities on a country, language and branch principle.

2. Collaborative Learning and Community Development. An important part is played by the tools for social extension implemented through the Social network Architecture (Fig. 2).

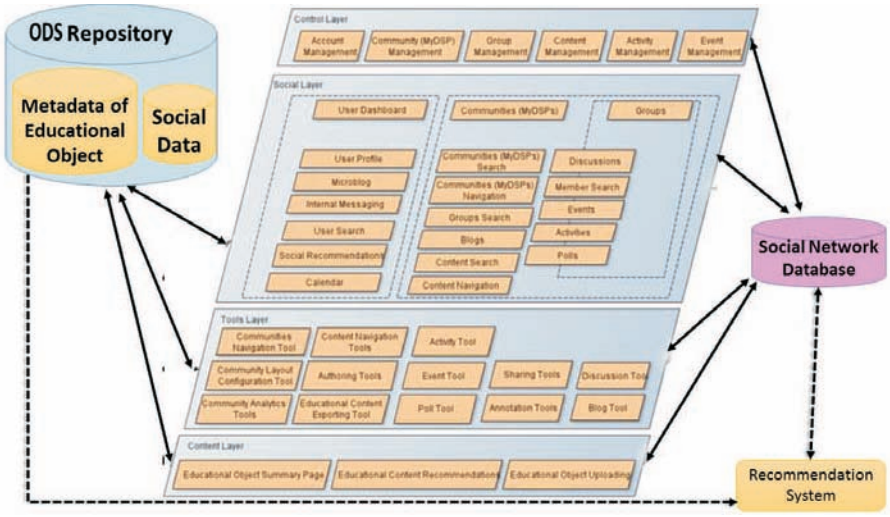

Fig. 2. Social network Architecture of the ISE WEB learning environment

The social empowerment of the environment based on the social network architecture is realized through an organization of a hierarchy of communities [17]. Each community has its own content, but authors can open their (viewable/searchable) objects to other communities, according to the hierarchical structure of the communities. The logic of the hierarchical structure of the communities forming the data flows are on Local, Regional, Thematic, National, International related to Public level and is given on Fig. 3.

Fig. 3. Hierarchy of ISE&ODS Communities

Contemporary eLearning tools and educational resources provide students and teachers with ample opportunities for inquiry in science education such as simulations, games, data sets, and/or remote and virtual laboratories. The ISE technology-enhanced Learning inquiry environment provides students with inquiry facilities together with an integrated supportive structure and scaffolds [3]. In this environment, technological affordance is directly used for pedagogical purposes, making the Inspiring Science education Inventory of eLearning tools an important part of the environment. It is divided into three basic categories: advanced technological applications, online labs (remote and virtual) and applications and educational repositories and portals. Shaping the Inspiring Science Inventory are virtual theme parks and laboratories, a mobile learning platform for context-dependent games, a multimedia e-learning system, an astronomical image analysing tool, 3D Games, real-time robotic telescopes, digital museum collections, hands-on projects combined with sensors and microcontrollers, etc. An important parameter is the grade level of the users, who can or are invited to be the creators to use the Inspiring Science Education eLearning tools. The result is an elaboration of Inspiring Science Education Demonstrators which follow

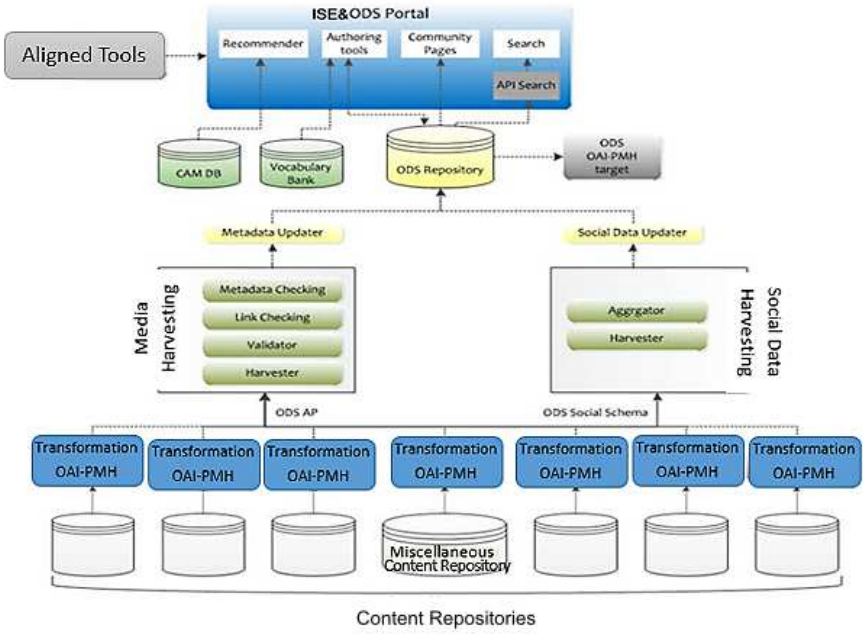

Fig. 4. Joint Open Discovery Space & Inspiring Science Education portal

the approach of inquiry learning while they are focused on (combining) numerous eLearning science tools and educational resources and integrate them with supportive structure and scaffolds of the environment. The use of ICT tools will also support the Inspiring Science Education assessment process as they can follow the students' tasks during the proposed learning activities and to demonstrate the impact of the intervention to their competence development

Then the learning process is realized in a blended mode, through a chain of workshops and exchanges, communities of practice and learning opportunities for science teachers and teacher trainers aimed at helping them find ways to make their teaching of science more inspirational, and in a distance learning mode, using the appropriate facilities of the environment. All this technologically is based on the joint Open Discovery Space & Inspiring Science Education portal, whose architecture is given in Fig. 4.

3. Roles of the Training Participants. After this short presentation of the ISE learning environment, let us see the roles of the key players in the education process, using this environment. As envisaged by the project these are Learners (guests), Teacher (tutor), Parent, Administrator, Expert, Analytic, Group moderator, Community manager, Content provider, Stakeholders (Fig. 5–10).

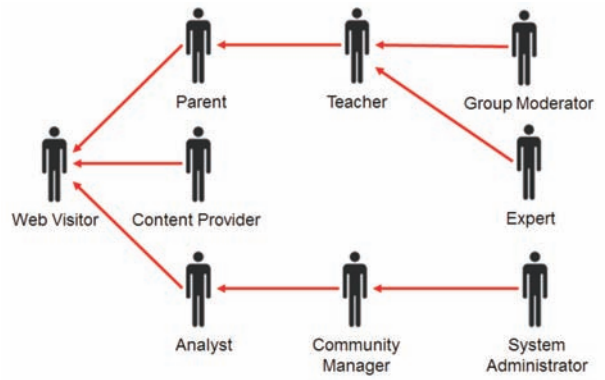

Fig. 5. Relations between these key players as given in the ISE project

After clarifying the respective roles transferred into requirements for the ODS&ISE WEB environment, we get to the role and relations of a new key player in the education activities in school—the Head of ICT[1] (E-facilitator) in school.

[1]This is a new profession in the Bulgarian school, whose main function is to help teachers

Teacher's view of the dashboard taking into account of his roles

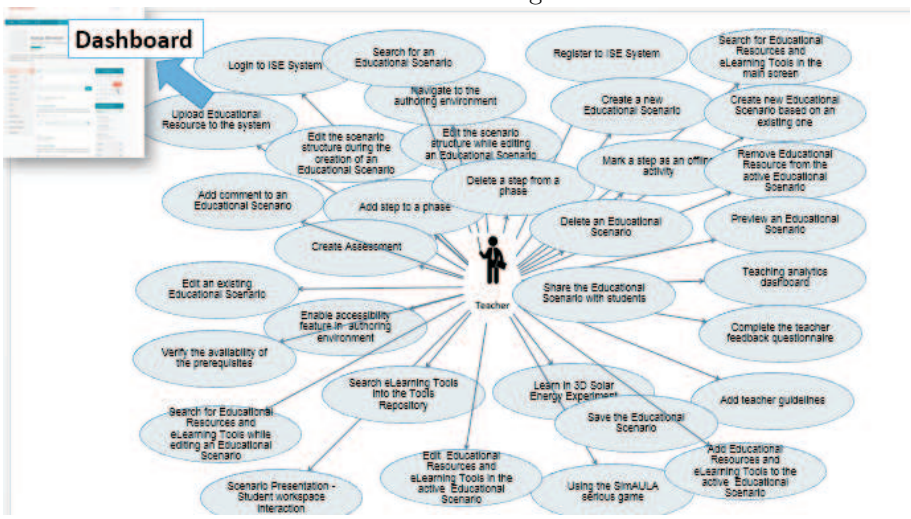

Fig. 6. Teacher's roles, viewed as requirements when creating ODS&ISE WEB environment

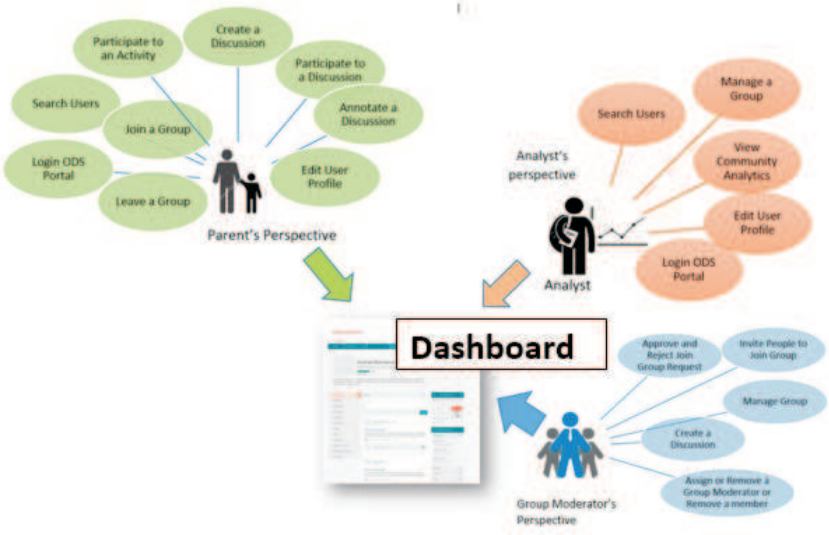

Fig. 7. Parents, Analysts, Group Moderator's roles, viewed as requirements when creating ODS&ISE WEB environment

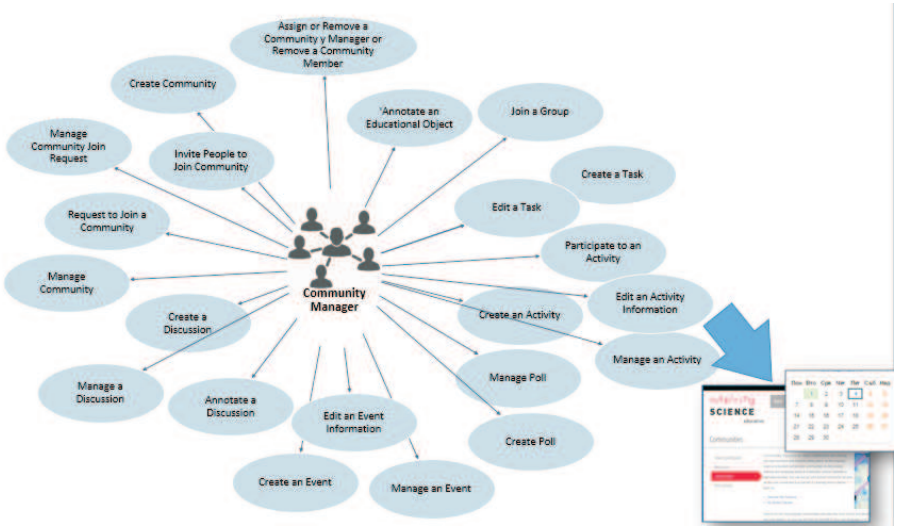

Fig. 8. Community manager's roles, viewed as requirements when creating ODS&ISE WEB environment

Fig. 9. Web visitor's roles, viewed as requirements when creating ODS&ISE WEB environment

Combined perception, taking into account all players

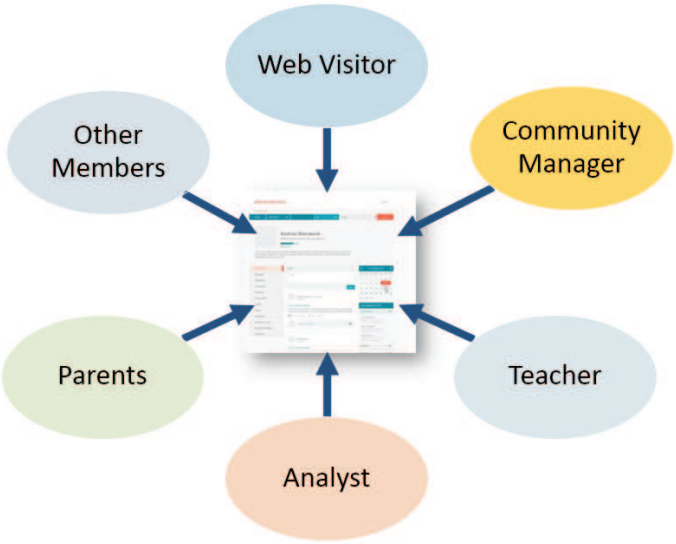

Fig. 10. The place of the e-Facilitator

4. The place of the e-Facilitator in school. This article gives a vision for the e-Facilitator in school, which helps teachers to express their subject—pedagogical ideas by means of technology.

In various EU countries including Bulgaria, starting from 2009, work was done to describe and categorize the professional profile of the e-facilitator[2], carrier of the mission to overcome the digital divide between the generations, through implementing ICT knowledge as a tool for those who "have not" become part of the information society. In recent years, our team worked and explored the needs for an e-facilitator in the school as a major ICT expert and consultant [10]. His main activities should be to facilitate access to the electronic services and information space, to support virtual libraries, to be an initiator and architect of social communication by forming communities involving all participants in the learning process—students, teachers, parents, and administration.

of all subjects to overcome problems in the use of ICT (National Programme "Development of Educational Professionals", Ministry of Education and Science, Bulgaria, 2016).

[2]Vocation Education and Training Solution for e-Facilitators for Social Inclusion (VET 4e-I)—Spain, Italy, France, Germany and Bulgaria; Transfer and Recognition of an eFacilitator Curriculum and Qualification, Project Number: **DE/12/LLP-LdV/TOI/147516**—Germany, Latvia and Portugal.

For a long time, in pedagogical science there lived the perception that expert teachers are those who combine deep knowledge of the subject with experience and the ability to choose the most beneficial forms of presentation of this knowledge. Pedagogical knowledge means the "how" of teaching. Content knowledge, on the other hand, is the "what" of teaching. This combination extended by Shulman (1986) is known as pedagogical content knowledge (PCK), where pedagogical knowledge means the "how" of teaching and content knowledge, on the other hand, is the "what" of teaching. In the 21st century, information and communication technologies (ICT) have provided new ways to access knowledge in each area. ICT evolved also pedagogy by providing new ways to engage students. These new technologies have changed the nature of the classroom or have the potential to do so. Mishra and Koehler added technology as an additional modeling component to pedagogical content knowledge framework of Lee Shulman's (PCK), making this framework more complete and comprehensive. **Technological pedagogical content knowledge** (**TPACK**) is a framework to understand and describe the kinds of knowledge needed by a teacher for effective pedagogical practice in a technology-enhanced learning environment [7, 8, 13].

The development of technology and access to huge amounts of information led to a change of lifestyle and communication. Curricula and teaching methods need to be continually assessed. There are new items and new professions. This requires continuous improvement of the teachers, not only in the subject area, but also in teaching, as well as in acquired technological possibilities for expression, taking into account that the old ways of communication and perception of information are unknown to new generations. On the other hand any change in technology leads to the need to invest time to learn new versions or new software directly. This whole process is a competition between individuals in their levels of ability, becoming a race whose conditions are influenced by technological progress. This contest continues to become increasingly more rapid and encounters a larger number of obstacles [7].

To require from teachers to know and use the whole variety of contemporary technologies and tools is nearly mission impossible, their task to always keep up with most recent technologies is resource and time consuming and often doomed to failure. Teachers exhibit leadership in multiple, sometimes overlapping, ways. Some leadership roles are formal with designated responsibilities. Other more informal roles emerge as teachers interact with their students. Here are some of the teachers' roles which they perform throughout the school day and over the course of the school year.

- Mediator of learning
- Disciplinarian or controller of student behavior
- Parent substitute
- Confidant to students
- Judge of achievement
- Organizer of curriculum
- Scholar and research specialist
- Member of teachers' organization
- Performer of roles in the community
- Public servant
- Expert in some area of knowledge or skills
- ICT Specialist
- Community leader
- Agent of social change

Considering the huge need of introduction of ICT in schools, the participants in the ISE project have provided a somewhat different vision of the responsibilities and activities of teachers, presented in the scheme (see Fig. 6).

And here comes the e-facilitator in school, to complement teacher activities and act as a mediator and interface between subject and pedagogy provided by the teachers (tutors) and technology as vital for the success of the learning process, facilitating content creation, community management [2], administration, analysis, moderation, parental supervision etc. He is the link between the subject and technological knowledge and acts as transferring bridge between pedagogical knowledge and new teaching methods influenced and caused by the continually evolving technological environment. In Fig. 11 are given the principal roles of the e-Facilitator in the context of the TPACK model [15].

From creating a learning scenario based on certain pedagogy, through elaborating the educational demonstrators, towards full-scale multimedia education material covering a given subject—these are the steps in which the active role of the e-facilitator in school is seen. Here is the place to discuss the roles of the key players in the learning process—teachers (tutors), e-Facilitator, learning environment managers, digital content providers, tool providers, stakeholders, education consultants, experts, community creators and managers, moderators, analytics, parents etc. on one side and learners (students), on the other.

Combined perception, taking into account all players

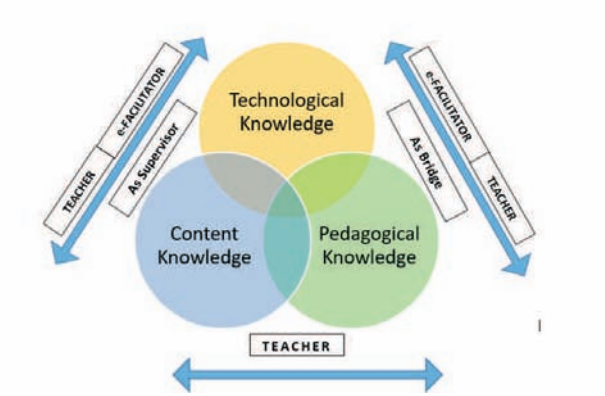

Fig. 11. The place of the e-Facilitator

Combined perception, taking into account all players

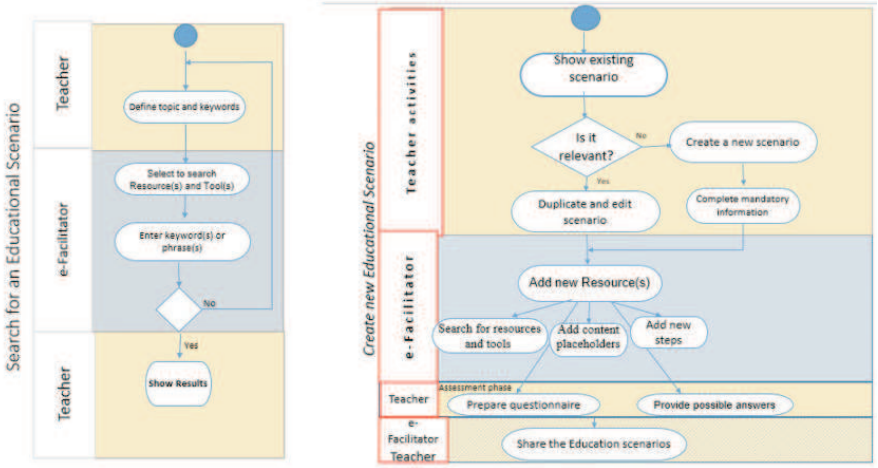

Fig. 12. Teacher–e-facilitator distribution of activities when creating (choosing) learning scenario

Here, we can give a scheme of distribution of the roles between teacher and e-facilitator in school when creating a new or choosing an existing learning scenario. In this scheme is visible the close cooperation of the e-facilitator with the other key players in the educational process in school [14].

The e-Facilitator obviously takes part in the roles and activities of the other key players in the learning process (Fig. 12), making the relations between

them more complex, and in the same time releasing them from technological, administrative, performance of authoring tools content creation, repository connectivity, content reusability, adhere parental functions, stakeholder interoperability on all levels and social communicability and cloud technology merge, creating real time ubiquity of access, store and retrieval, removing time and distance constrains [16].

By including the e-Facilitator as a new key player in the learning process we obtain a more complex picture of the key players, their hierarchy, roles, dependencies, interconnectivity and data flow. Applied to the ISE project learning environment we receive the scheme shown on Fig. 13 compared to the scheme in Fig. 5, reflecting the hierarchy and relations in ISE project environment it leads to a significant increase of the weight of the e-Facilitator in the teaching model and content creation, making him a technological hub of pedagogical content knowledge (PCK) in school.

It is becoming more and more apparent that "one size fits all" learning solutions are no longer enough to satisfy learners' educational needs, which should be considered as input parameters in the process of personalization of learning, binding them with the construction of the learning plan and with the appropriate learning resources [5]. There are a number of factors that can influence the extent and tempo of learning: Learning styles; Learner Goals/Objectives; Previous Knowledge; Educational Level and Difficulty; Technical Preferences; Other Preferences; IQ level of the learner; threshold and level of perception of the learner; etc.

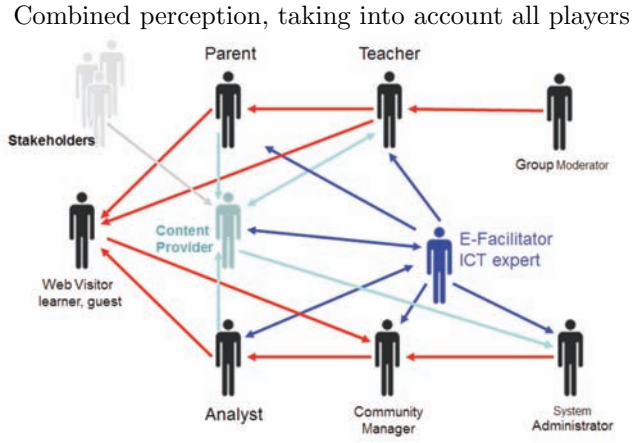

Fig. 13. Enhanced relations between these key players as given by the authors

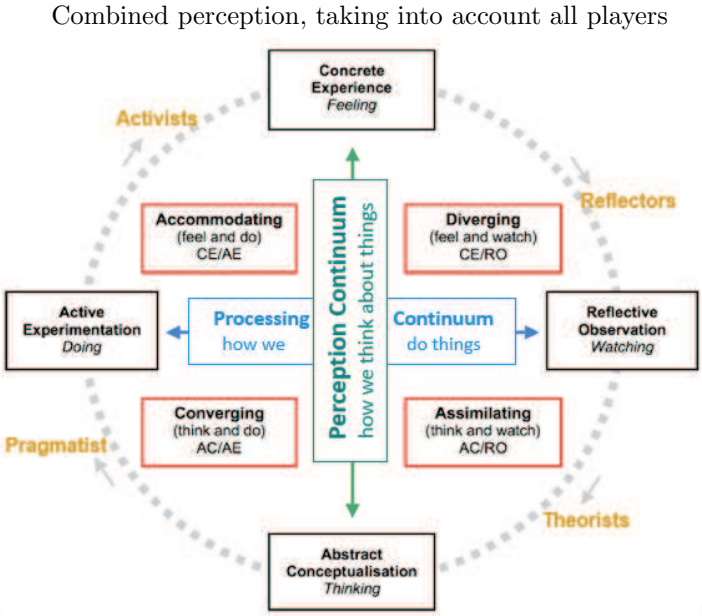

Fig. 14. Honey & Mumford's learning styles and their relation to Kolb's learning styles

Learning styles can be generally described as "an individual's preferred approach to organizing and presenting information" [12]; "the way in which learners perceive, process, store and recall attempts of learning" [18]; "distinctive behaviours which serve as indicators of how a person learns from and adapts to his environment, and provide clues as to how a person's mind operates"; "a gestalt combining internal and external operations derived from the individual's neurobiology, personality and development, and reflected in learner behaviour [6], "the attitudes and behaviours which determine an individual's preferred way of learning" [1]. Although many different learning styles models exist (according to literature reviews more than 70 different style models are classified), Kolb & Honey & Mumford's learning styles [9] as given in Fig. 14 [4, 9, 11, 18] form the key styles taking into account the differences in individuals' learning.

Important are the role functions of the e-facilitator in personalizing the learning process, in both directions—content and pace of learning, matching the education materials to the individual needs of the learner and according to his capacity and style of learning in the context of STEM (science, technology, engineering, and mathematics) education.

This ensures the more complex perception of the relations and flaws: Stakeholder – Content provider; Web visitor – content (LMS, CMS, reposito-

ries); Web visitor – Community; Teacher (author) – Content provider; Parent – Content provider, Parent-teacher (author); Community creation –community management; School educational content – administration; Quality assurance; Quant ITive, environment, statistical and event Analysis; Tutoring of Web visitor, Authors, content providers, stakeholders, parents; Functional Help desk for the environment; etc. In all these relations, the e-facilitator in school plays a key role, which points to the necessity and importance of the e-Facilitator in school for the learning process and the evolving of the learning environment with the appropriate repositories and digital libraries, storing and assuring reusability and multiple access to the educational content in different contexts.

The scope of future investigation will be toward the steps for creation of an educational cloud and the role of the e-Facilitator in school as a router and gatekeeper to the cloud for the school.

Here we must pay tribute to the over twenty-five years of leadership in STEM education of Prof. Edward A. Friedman and his impact on Bulgarian education during his 6 months' stay in the country.

When Dr Edward Friedman founded CIESE in 1988, computers and the Internet were just emerging into public view and had little role in education. Ed, knowing that students' success and innovation in science, technology engineering and mathematics at the university level depended on their prior experience, evaluated the potential embracing "new technologies" and the responsibility to influence pre-college education. He was one of the pioneers in application of computers in personalizing the learning process, in both directions—content and pace of learning, matching the education materials to the individual needs of the learner, according to his capacity and style of learning in the context of STEM.

In the early nineties he visited Bulgaria, exerting key influence on a whole generation of IT specialists and educationalists in technology-enhanced learning with application of computers in STEM.

This coincided with the World Wide Web going public in 1991. These Bulgarian specialists engaged teachers in using computer-based software applications to support learning of mathematics, providing them with professional development to learn how to use unique and compelling Internet-based curriculum materials to support science and math learning.

The authors have the honor to personally know Ed and have been among the specialists who follow and disseminate his ideas for using computers for education purposes in school and university. They were among the first to propose the idea of "Multimedia Knowledge Village" in Europe (prototype of the contemporary digital university campus).

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Radoslav Yoshinov
e-mail: yoshinov@cc.bas.bg
Monka Kotseva
e-mail: mkotseva@cc.bas.bg
Laboratory of Telematics
Bulgarian Academy of Sciences
Acad. G. Bonchev St, Bl. 8
1113 Sofia, Bulgaria